

# Bugs and Challenges in IoT Development

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## Demographics

These data will only be **only** used to give overall statistics about all survey participants. Your data will be kept anonymous and safe.

How many years of experience do you have in general software development and IoT development?

	Less than 1 year	1-3 years	3-5 years	5-10 years	More than 10 years
General development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
IoT development	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

**Which of the following best describes your experience with IoT systems?**

- ☐ Worked with IoT systems as an academic or industrial researcher
- ☐ Worked with IoT systems as an industrial developer
- ☐ Worked with IoT systems as a freelance developer
- ☐ Others (please specify)

**What is your field of expertise in IoT development? (select all that apply)**

- ☐ IoT hardware
- ☐ IoT middleware (communication with IoT devices)
- ☐ IoT platform/hub/cloud services
- ☐ IoT end-applications (IoT web/mobile applications for end-users)
- ☐ Others (please specify)

**What domain your IoT system has been developed for?**

- ☐ Industrial
- ☐ Home automation
- ☐ Healthcare
- ☐ Education
- ☐ Retail
- ☐ Transportation
- ☐ Agriculture
- ☐ General-purpose IoT platform or IoT service (not for specific domains)
- ☐ Others (please specify)

## Challenges of IoT Developers (Q1-Q6)

**(1/10) How do you/your company test your IoT system?**

- ☐ Completely manual
- ☐ Completely automatic
- ☐ Hybrid: combination of both manual and automatic
- ☐ Others, please specify

**(2/10) Who is responsible for testing the IoT system in your company/project?**

- ☐ Developers
- ☐ QA team or testers
- ☐ Third party services
- ☐ No testing is performed
- ☐ Others, please specify

**How much do you agree with each item as being a challenge for IoT developers?**

### (3/10) Testing and Debugging Challenges

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
<b>You need real devices for testing and debugging the IoT system</b> Device simulation and mocking IoT devices for the purpose of testing IoT is not practical yet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Testing against diverse devices and protocols is a challenge</b> Hard to make sure your IoT system works well with all combinations of devices/protocols	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Logs and notification data from lower levels are not easily available</b> Have to manually investigate the failures and corruptions, not good failure reporting from lower level components	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Large-scale/edge-case scenarios are challenging while testing IoT</b> Hard to test and debug special states of the hardware, or environment... hard to test with lots of devices or test with large rates, or volume of data,...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Reproducing the bug in IoT is a challenge</b> Hard to repeat the breaking scenario.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### (4/10) Heterogeneity Challenges

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
<b>Hard to add integration and support for a new technology in IoT</b> For a device, communication or network protocol, external IoT platform or service, ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Keeping up-to-date with latest releases in context of IoT is challenging</b> Devices, OS, protocols, or third party libraries may release updates too often or without prior notice.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Interpreting diverse technologies of IoT is challenging</b> Challenge of Learning, understanding, and using each technology. Challenge of searching, choosing, and configuring a new technology to your current IoT system	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### (5/10) Security Challenges

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
<b>I'm not confident about the security of third-party components in my IoT system</b> Third-party components like network protocols, devices, libraries, operating systems,...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Security mechanisms related to IoT devices are challenging due to device resource constraints</b> Challenges such as generating or storing tokens in devices,...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Security is a complex problem in my IoT system</b> Existence of various attack surfaces, complex auth procedures, architectural complexity of the IoT system,...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## (6/10) Other Challenges

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
<b>Releasing patches and updates for my IoT system is challenging</b> Hard to release and deploy an update for my IoT system to fix/enhance a bug/feature without causing any breakage or too many effort	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Handling IoT data is challenging</b> Handling large scale or real-time data from IoT devices, keeping a back-up of data, not losing any telemetry data,...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>The IoT architecture is challenging to deal with</b> Challenge of designing the right architecture for the IoT system, avoiding complex or flawed architecture for the IoT system, or understanding and interpreting an existing architecture.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Dealing with limitations of IoT devices is challenging</b> Restrictions of devices in supporting different technologies, constraint resources, known issues in some IoT devices,...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Handling failures of IoT systems in a gentle way is challenging</b> Hard to handle failures in a way to not lose data and to keep the system available	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What are the main challenges of IoT developers in your opinion?  
What challenges are not mentioned?

## Bugs in IoT systems (Q7-Q10)

Based on your previous experiences, please select:

- How frequently do you face each bug?
- Have you ever faced a severe occurrence of the bug?

## (7/10) Hardware and Firmware of IoT Devices:

	How frequently?					Ever faced a time-consuming or impactful example of it? Consider impact or fix-time of the bug	
	Very frequently	Frequently	Sometimes	Rarely	Never	Yes	No
<b>Physical entity of the device</b> Bugs related to/because of only the hardware of the device like wiring issues, button not working, ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Device firmware</b> Bugs related to/because of semantic/syntactic bugs in the device firmware code	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Device configuration</b> Bugs related to/because of configuring IoT devices.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Firmware upgrade</b> Bugs related to upgrading the IoT device firmware like stale upgrade or failure in upgrading	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Device constraints: battery, memory, processing</b> Bugs related to limited resources of devices like bugs that happen when the device is low on battery, or memory overflow,...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### (8/10) Communication with IoT Devices:

	How frequently?					Ever faced a time-consuming or impactful example of it?	
	Very frequently	Frequently	Sometimes	Rarely	Never	Yes	No
<b>Messages and telemetry data issues</b> Bugs related to the delivery of messages or telemetry data, timing and rate of messages, the content of messages (wrong data),...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Connectivity and network issues</b> Bugs related disconnection, re-connection, or forming connection of IoT devices, bugs related to unreliable network, or network discovery issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Device connection status issues</b> Wrong or unknown connection status of IoT devices	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Compatibility issues</b> Bugs related to incompatibility with communication or network protocols or standards, device-related protocols or standards, or platform-related standards	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Select "frequently" and "yes" for this item.</b> This item is just to validate the participants' attention.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### (9/10) IoT Cloud and Edge Services:

	How frequently?					Ever faced a time-consuming or impactful example of it?	
	Very frequently	Frequently	Sometimes	Rarely	Never	Yes	No
<b>Device state issues</b> Bugs related to reading/writing the correct device state	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Issues with setting up the device</b> Bugs related to device discovery, identification, registration, provisioning, or binding...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Rules and automations issues</b> Bugs related to generating or executing automations in IoT	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

### (10/10) General Development:

	How frequently?					Ever faced a time-consuming or impactful example of it? Consider impact or fix-time of the bug	
	Very frequently	Frequently	Sometimes	Rarely	Never	Yes	No
Installation, compilation, or dependency issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Auth issues Bugs related to authentication, authorization, or permissions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Performance issues of the IoT system Bugs related to delays, optimizations, ...	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
UI and usability issues	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
External bug in third party services	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Do you have anything to add to above categories of bugs?  
 Any other IoT bugs, examples and observations, or any solutions to deal with them.

Done. Thanks for your participation.